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ADOLESCENT FOOD PURCHASING PATTERNS AND THE ASSOCIATION WITH DIETARY INTAKE AND BODY MASS INDEX IN RURAL COMMUNITIES IN KENTUCKY AND NORTH CAROLINA

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Digital Object Identifier: <https://doi.org/10.13023/ETD.2017.466>

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ADOLESCENT FOOD PURCHASING PATTERNS AND THE ASSOCIATION WITH
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KENTUCKY AND NORTH CAROLINA

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in Nutrition and Food Systems
in the the College of Agriculture, Food and Environment
at the University of Kentucky

By

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Lexington, Kentucky

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Nutrition

Lexington, Kentucky

2017

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ABSTRACT OF THESIS

ADOLESCENT FOOD PURCHASING PATTERNS AND THE ASSOCIATION WITH DIETARY INTAKE AND BODY MASS INDEX IN RURAL COMMUNITIES IN KENTUCKY AND NORTH CAROLINA

The local food environment plays an important role in the health of adolescents, especially in rural areas. Often, rural areas lack the accessibility and availability of healthy food choices, making a healthy lifestyle difficult to achieve. This study presents a cross-sectional survey of rural adolescents in 8 counties in Kentucky and North Carolina to determine the association between food store choice, body mass index (BMI), and key dietary outcomes. Although BMI had no association with food store choice, those who infrequently shopped at gas stations, convenience stores, and fast food restaurants consumed significantly less added sugar ($p < 0.05$) than those who shopped at those stores more regularly. Increasing the availability and accessibility of food venues with healthy food options such as supermarkets may decrease added sugar intake among rural adolescents.

KEYWORDS: Consumer Food Environment, Adolescent Obesity, Rural Food Environment, Shopping Patterns, Fruits and Vegetables

Paige Michelle Connelly
November 29, 2017

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ACKNOWLEDGEMENTS

There are many people that I would like to thank for their guidance and assistance through the development of this thesis. First, I would like to thank Dr. Alison Gustafson for the continued encouragement and support from the very beginning. This thesis would not have been possible without her ongoing support. I also would like to thank my committee members, Dr. Sandra Bastin and Dr. Janet Mullins for their interest in my thesis and their feedback. I would like to thank the key stakeholders within the counties we travelled to including, but not limited to: UK Cooperative Extension Agents, UK graduate students, Principles, and Teachers who all made this research possible. Last, I would like to thank my friends and family for the ongoing love and encouragement I needed to complete this thesis and Master Degree.

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Chapter One: Introduction

Background

Studies have shown that food environment has an impact on the health and diet of those living within that environment, especially among the rural populations (Bibiloni et al., 2013, Hill et al., 2014, Rouhani et al., 2012, Liese et al., 2007, Morland & Evenson, 2008, Rose & Richards, 2004, Dean & Sharkey, 2012). The rural food environment is more limited than the urban food environment, in regard to proximity to stores selling healthy food items (Bibiloni et al., 2013, Hill et al., 2014). Those who have limited access to grocery stores report higher intake of sugar-sweetened beverages and consume fewer fruits and vegetables (Rose & Richards, 2004, Michimi & Wimberly, 2010, Jilcott et al., 2011). This leads to higher rates of obesity than urban communities (Befort et al., 2012). Given that rural populations, which comprise 23% of the population, face barriers unique to their geographic landscape, evidence-based strategies are needed to improve health outcomes among this sub-population (Hill et al., 2014).

Different types of food venues including supermarkets, convenience stores, and fast food venues play a key role in the food environment in which people live. Supermarkets are associated with higher intake of fruits and vegetables and lower BMI (Jilcott et al., 2011, Rose & Richards, 2004). In many rural communities, people live on average 13.6 miles (22 kilometers) from a supermarket, three times the distance than those living in urban areas (Michimi & Wimberly, 2010).

Numerous studies have determined the relationship between distance from food venue and key dietary outcomes and BMI, but research is still needed to determine the relationship between actual food shopping behaviors and key dietary outcomes and BMI.

Problem Statement

Adolescents face unique challenges and opportunities in regarding healthy food purchases that may improve long-term health outcomes. Rural adolescents have limited access to food venues at this critical time point while developing eating and food purchasing behaviors. This study aims to understand how food-purchasing patterns are associated with dietary intake among this vulnerable sub-population.

Statement of Purpose

The purpose of this study was to examine the effect of food shopping location among adolescents and how it might be related to their dietary intake and weight status in rural communities throughout Kentucky and North Carolina. To achieve this goal, the following aims were developed based on a cross-sectional survey among 14-15-year-old adolescents in Kentucky and North Carolina.

Research Questions

1. Does the location of adolescent food purchases have an impact on key dietary outcomes?
2. Does the location of adolescent food purchases have an impact on BMI?

Research Aims

1. Determine the association between food shopping patterns and food purchases.
2. Determine the association between food shopping patterns and BMI.

Hypothesis

1. Adolescents that have healthy eating patterns will purchase more fruits and vegetables and less sugar sweetened beverages and snack items even at various types of food venues compared to adolescents with unhealthy shopping patterns.

2. Adolescents who shop more frequently at convenience stores, gas stations, and fast-food restaurants are more likely to have a higher BMI than adolescents who shop at supercenters and grocery stores.

Justification

The food environment in rural communities is very different from urban communities (Bibiloni et al., 2013, Hill et al., 2014). Food access and availability shape what people are able to purchase (Gebremariam et al., 2017). With the higher obesity rates in adolescents of rural communities versus urban communities, it is important that research is done to determine if food store choice has an impact on diet and BMI in rural communities.

Chapter Two: Literature Review

Introduction

There remains a gap in understanding why rural adolescents are disproportionately affected by higher rates of obesity compared to their urban counterparts (Bibiloni et al., 2013, Hill et al., 2014). Recent studies over the past 15 years have begun to address environmental exposures as a key determinant in higher rates of obesity. Within the context of environmental exposures, the term “food deserts” has been coined. These geographically isolated communities with few to no grocery stores within a neighborhood. Research suggest that limited access to different types of grocery stores may contribute to rates of obesity, especially among rural and adolescent populations.

In rural communities, the food environment in which people live has shown to have a large impact on fruit and vegetable intake, added sugar consumption, and obesity prevalence. Some of the most important factors in the food environment are addressing accessibility, availability, and food store choice. Each type of food store (fast food, corner stores/gas stations, supermarkets, and supercenters) has shown to vary in fruit and vegetable intake, added sugar consumption, and obesity prevalence, based on proximity to each food store (Rouhani et al., 2012, Liese et al., 2007, Morland & Evenson, 2008, Rose & Richards, 2004, Dean & Sharkey, 2012). Access is vital for all communities to thrive, but given the added constraints of proximity and economic instability in rural communities the food environment plays a unique role in food store choice and subsequent health outcomes.

Socioecological Model

Food choice begins at the individual level of the Socioecological Model. The

individual level explains how knowledge can influence food choices, meal preparation, and attitudes toward food choices. At the interpersonal level, parents, peers, and friends influence choices. Adolescents may become more prone to influences of friends than at any other time in their life (Contento et al., 2006). A lot of socialization is based around food, whether that's receiving food as a reward, going out to eat with friends, or stopping by the corner store on the way home from school. The next level in the Socioecological Model is the organizational level. Many adolescents in rural areas receive a free lunch from school. Within the school setting, access to school lunch, a la carte, and vending machines can have an impact on food choices. Within this level of influence, adolescents have the opportunity to choose from limited options, therefore taking the decision away from the student. The community level encompasses much of the food environment. This includes the availability of healthy options in the grocery stores, access to grocery stores, and placement and number of fast food venues, gas stations, corner stores, supermarkets, and supercenters within a given area. The last level of the Socioecological Model is public policy. Policy includes things such as an increase in tax on sugar-sweetened beverages, limits on advertising to children, and enforcing that all children have at least a fruit or vegetable on their lunch tray in school.



A Social-Ecological Model for Physical Activity - Adapted from Heise, L., Ellsberg, M., & Gottemoeller, M. (1999)

Figure 1: A Social-Ecological Model for Physical Activity- Adapted from Heise, L, Ellsberg, M, & Gottemoeller, M (1999)

One of the most important things to realize about the Socioecological Model is that most interventions do not just focus on one level. There is usually an overlap in the levels, which is a good thing. Interventions that only address one level of the Socioecological Model are often not as successful as interventions that intend to address multiple levels of influence upon a person.

Obesity among Adolescents

In the US, 15.2% of all adolescents are overweight and 16.4% are obese (Bibiloni et al., 2013). A person has an 80% chance of being obese as an adult if they are obese between the ages of 10 and 13 (AAP, 2015). In rural communities, rates of childhood and adolescent obesity are 26% higher than children and adolescents living in urban communities (Johnson III & Johnson, 2015).

There is a myriad of reasons for the high rates of obesity among US adolescents. Many studies have pointed to a lack of physical activity, an increase in screen time, poor

dietary habits, a decrease in family meals, and an increase in availability of healthy food, while at the same time an increase in availability of unhealthy food (AACP, 2015, Harvard T.H. Chan, 2017). Taken together targeting one determinant does not take into account all levels of influence. However, understanding how rural adolescents' environment may impact their diet and obesity status has merit for the broad public health impact it may have.

Obesity among Rural Communities

Twenty-three percent of the US population lives in rural areas (Befort et al., 2012). These rural communities have a greater prevalence of overweight and obesity than urban communities (Hill et al., 2014). Obesity is a product of behavior, socioeconomic status and education. Geographic isolation can be a large factor that interacts with behavior, socioeconomic status, and education, which provide a perfect storm for high obesity rates (Dean & Sharkey, 2011). People living in rural communities tend to have a lower income and education levels, which may influence prevalence of obesity as well (Hill et al., 2014).

One study conducted 784 phone surveys in rural Virginia and North Carolina (Hill et al., 2014). This survey asked about demographics, BMI, physical activity, and fruit and vegetable intake. 30% of these residents reported their household income as less than \$20,000. Only 9% of the surveyed population consumed the recommended amount of fruits and vegetables compared to 23% nationwide. Finally, 11% met the recommendations for cardiovascular and strength training physical activity recommendations. This compares to 23% nationwide (Hill et al., 2014). Another study found that 45.1% of the children were overweight and 27.4% were obese, with 17.7%

falling between the 85th and 95th percentile (Williamson et al., 2009). These numbers are significantly higher than the national average of 30% total overweight and obese children (Bibiloni et al., 2013). NHANES conducted a multistage, clustered probability study, which included 7,325 urban residents and 1,490 rural residents (Befort et al., 2012). Their BMI, diet, and physical activity were measured. The prevalence of obesity in urban communities was 33.4% and 39.6% in rural communities (Befort et al., 2012). Diet quality also varies based on socioeconomic status and demographics. On average, the populations as a whole, needs to consume a more healthful diet, but in particular, there are positive correlations between income and diet quality as well as education levels and diet quality (Hiza et al., 2013). From this research, it can be concluded that rural, poorer, and less educated communities experience obesity and a poorer diet quality more than the rest of the nation.

These rural residents also reported having a greater percent of daily calories from fat than urban residents. This is potentially because of the way the foods are prepared and the limited access to healthy foods. Physical activity and total calorie intake were not significantly different in the rural and urban residents (Befort et al., 2012). From this, it can be concluded that the difference in obesity prevalence is due to the specific diets of rural residents.

Dietary Pattern

Over the past few decades, there has been an undeniable shift in the Western diet. This includes an increase in high fat, sodium, sugar, and processed foods, and a significant decrease in the consumption of fruits, vegetables, and whole foods. Children are still not meeting the appropriate dietary recommendations (Krebs-Smith, 2010).

Vegetable and dairy recommendations are not met by over 90% of children, and their usual intake consists of solid fats and added sugars. Along with that, the maximum recommended meat and bean intake was surpassed by 10% of the population and another 10% surpassed the maximum recommendations for grains (Krebs-Smith, 2010).

Food Environment

Food environment is the food that a person comes into contact with and how that affects their diet (CDC, 2014). Within the food environment is the neighborhood food environment, which is the type of food stores that person lives within a certain geographic distance (Glanz et al., 2005). Assessing the food environment is crucial to developing effective interventions with a specific geographic region (Gebremariam et al., 2017). The three main aspects of the retail food environment are availability, accessibility, and store choice.

Food availability can be defined in many ways. In this context, however, it is quite simple. A food item is considered available if it is offered or sold in a specific place (Gebremariam et al., 2017).

Food accessibility is a little more complex than availability. Food items need to be economically and physically accessible (PhilFISIS, 2017). Economic accessibility is dependent on what families can afford. For example, apples may be available in a grocery store, but if the apples are \$5.00 a pound, a family may not be able to afford it, and the apples are therefore not economically accessible. Foods are physically accessible if infrastructure facilitates the access to foods. For example, if only one grocery store in a county has whole grain pasta, and that grocery store is 40 miles away, then whole grain pasta is not physically accessible.

The outlets in which people shop also influence the foods that they purchase (Krukowski et al., 2013). People do have a decision to make when it comes to store choice, but most people shop for food at stores that are the closest and most convenient for them. Other influences on store choice include pricing of certain food items and quality of the food that vary in different food outlets (Krukowski et al., 2012).

Linking Diet and Obesity to Food Environment

Research has shown that those living in rural areas or further from traditional food outlets are associated with obesity and chronic disease (Valdez et al., 2016, McDermot et al., 2017). One systematic review of 38 papers assessed the food environment and diet (Capsi et al., 2016). The studies that analyzed food availability and diet showed that there is a positive correlation between having healthy foods available and a healthy diet. However, the studies that analyze the perceived availability of foods resulted in no relationship between availability and dietary outcomes (Capsi et al., 2016).

This review also included studies that measured physical accessibility and economic accessibility. Physical accessibility was measured by the distance to a food outlet from their home and the impact it had on their diet. One study found that residents who live farther from a fast food restaurant have a higher vegetable intake than those who live closer to a fast food restaurant (Capsi et al., 2016). Economic accessibility was measured by the perceived price of fruits and vegetables. Surprisingly, two studies showed that people who perceived fruits and vegetables to be “too expensive”, were more likely to eat more fruits and vegetables than those who thought fruits and vegetables were reasonably priced (Capsi et al., 2016).

Another study also showed the effect of food prices and economic accessibility on

diet in children and purchasing behavior (Beydoun et al., 2011). Based on two 24-hour dietary recalls, a Healthy Eating Index (HEI) score, fast food consumption indices, and food price indices, this study found that food prices impact the food children consumed. Children who lived in areas with higher fast food prices consumed less fast food, had a higher HEI score, and consumed more fruits and vegetables. Alternatively, children who lived in areas with higher fruit and vegetable prices consumed less fiber, but did not have an increase in fast food consumption. Also, children living in areas with higher fruit and vegetable prices on average had a higher BMI, which was more prominent in low-income areas (Beydoun et al., 2011).

Role of Store Choice in Adolescents' Dietary and Obesity Status

Fast Food Venues. Fast foods are high in saturated and trans fats, and research has shown that fast foods may have increased the prevalence of obesity (Rouhani et al., 2012). One study done in Iran looked at fast food consumption and how that has an impact on the quality of diet and obesity in 140 adolescent girls. Their diets were assessed using a food frequency questionnaire with 53 food items. The FFQ was then compared to three separate 24-hour recalls in order to determine validity. BMI, abdominal obesity, and physical activity levels were also taken. The results from this study showed that there was a statistically significant relationship between fast food and increased BMI and waist circumference. This is most likely due to regular fast food consumers consuming 1500 more calories per day and 25 more grams of fat than those who do not (Rouhani et al., 2012).

Gas Stations and Corner Stores. A cross sectional survey done in rural South Carolina found that the majority of the food stores available were convenience stores

connected to gas stations (Liese et al., 2007). Of 77 stores identified in the county, 74% were convenience stores. The healthy food available in convenience stores is quite limited in comparison to supermarkets. For example, fruits and vegetables were available in only 4% of the convenience stores and nonfat milk in 2%, but 30% sold bacon, 68% offered whole milk, and 86% had low fiber bread. These results show that although food outlets are readily available in rural areas in the form of convenience stores, they do not sell the healthy options that are more readily available in a supermarket setting. When people are shopping at convenience stores that offer more processed foods and less fruits and vegetables, there is a higher prevalence of obesity in those areas (Liese et al., 2007).

Not only is it apparent that the lack of healthy foods in convenience stores contributes to unhealthy eating, there are also a correlation between increased obesity rates and location of convenience stores and gas stations (Morland & Evenson, 2008). Each mile someone lives closer to a convenience store, they are 9% less likely to be obese, but each mile someone lives close to a convenience store/gas station combination, they are 19% more likely to be obese (Morland & Evenson, 2008). Generally speaking, gas stations with unhealthy options are associated with unhealthy eating and higher prevalence of obesity.

In 2004, a Healthy Corner Store Initiative began (The Food Trust, 2014). This program's goal was to increase the access and availability of healthy foods available in corner stores in Philadelphia, and encourage consumers to choose the healthier options. Research had previously shown that 53% of adolescents shop at corner stores every day. Not only that, but they spend \$1.07 and consume an average of 356 calories per visit. The initiative focused on including healthy inventory, marketing towards these new healthy

foods, training the storeowners, and including “Healthy Corner Store” certifications for stores that successfully made the change. This initiative wasn’t introduced to decrease the amount of processed foods available in corner stores, but to increase the amount of healthy options to consumers. The initiative found that there was an increase in profits in the corner stores and in customer demand for health products. Although research is still being done to determine whether the Healthy Corner Store Initiative is an effective way to decrease obesity rates and increase fruit and vegetable consumption, it has proven to be effective in increasing the customer demand for healthy options (The Food Trust, 2014).

Supermarkets. Supermarkets in suburban areas have lower prices in comparison to urban and rural areas (Rose & Richards, 2004). Also, those living in a closer vicinity to a supermarket on average consume more fruits and vegetables than people who do not. In a study done by Rose & Richards et al., fruit and vegetable consumption was compared to access to a supermarket. It was found that people who live within 5 miles of a supermarket consume 0.41 more servings (62 grams) of fruit and 0.24 more servings (36 grams) 36 of vegetables than people who live further from the supermarket and closer to convenience stores (Rose & Richards, 2004).

Investigators in South Dakota studied obesity and fruit and vegetable consumption as related to residential distance from a supermarket (Michimi & Wimberly, 2010). The study found that in metropolitan areas, 21.3% were obese and 24.2% consumed greater than or equal to 5 servings of fruits and vegetables per day. In non-metropolitan areas however, obesity was up to 24.6% and consumption of 5 or more fruits and vegetables per day dropped to 21.5%. These results were directly correlated

with distance from a supermarket ($p < 0.01$). The average distance households were from a supermarket in metropolitan areas was only 2.8 miles (4.58 kilometers), while in non-metropolitan areas that number jumped up to 5.2 miles (8.35 kilometers), or almost double the distance of metropolitan households. When considering size of the supermarket the results change quite a bit. The average distance households were from a large supermarket in metropolitan areas was 4.82 miles (7.75 kilometers). In non-metropolitan areas, that number jumps up to 13.55 miles (21.80 kilometers), or about three times the distance (Michimi & Wimberly, 2010).

Supercenters. Over the last few decades, there has been a significant increase in the prevalence of supercenters (Jilcott et al., 2011). A study done in the US looked at the association between obesity prevalence and supercenters. The results showed that there is a negative association (-4.75) between obesity and supercenters ($p=0.0219$) (Jilcott et al., 2011). This study acknowledged that in previous research, a reason that supercenters were associated with higher obesity prevalence is because of the additional food venues (i.e. fast food) that tend to surround supercenters.

Another study done in Texas used random-digit dialing to assess the health of the population in Brazos Valley (Dean & Sharkey, 2012). The study measured fruit and vegetable intake, household resources, demographics, and objective retail food environment. The results showed that participants who lived farther from a supercenter, on average, had a lower fruit and vegetable intake than those who live closer to a supercenter. In this study, the rural participants were an average of 5 miles further from a supercenter than their urban counterparts (Dean & Sharkey, 2012).

Summary

The food environment in which people live plays a large role in their diets. While accessibility and availability to healthy food options are things that people in rural communities cannot control, food store choice also plays a large role in the foods that people purchase and consume. Research has shown that those who live closer to fast food venues, gas stations, and corner stores tend to have a diet high in saturated fats and added sugars, while those living closer to supermarkets and supercenters have diets higher in fruits and vegetables (Rouhani et al., 2012, Liese et al., 2007, Morland & Evenson, 2008, Rose & Richards, 2004, Dean & Sharkey, 2012).

Gap in Research. From this review of the literature, we can conclude that proximity to certain food stores has an impact on the diet of those living around them, however, the relationship between where people predominantly shop and dietary intake is still unknown. The purpose of this study is to examine the effect of where adolescents choose to purchase food and how that might be related to their dietary intake and weight status in rural communities in Kentucky and North Carolina.

Chapter Three: Methodology

All procedures were approved by the University of Kentucky (UK) Institutional Review Board (IRB).

Study Design

This study was designed to examine the relationship between the food environment and key dietary outcomes and body mass index (BMI). The research design was a cross-sectional survey. Adolescents' parents or legal guardians provided written consent for the participants to complete the survey.

Participants

Kentucky adolescents living in Clinton County, Greenup County, and Knox County, and North Carolina adolescents living in Corbin County, Edgecombe County, Greene County, Lenoir County, and Pitt County were asked to participate in the study. Each county high school was contacted to participate in the study. Schools were selected based on location and agreeing to allow time for students to take the survey. A total of seven high schools in Kentucky were contacted and three agreed to participate. A total of six high schools in North Carolina were contacted and four agreed to participate.

Parents and students were informed of eligibility prior to consent. Eligibility to participate: adolescents must (1) be between the ages of 14 and 16 years old, (2) speak English as their primary language, (3) not report any serious illness that would alter dietary patterns (such as diabetes, Crohn's disease, etc.), (4) return a signed consent form. If more than one adolescent eligible to take the survey lived in the same household, the parent/guardian must decide which adolescent would participate in the study.

Procedures

Once eligibility was established, trained graduate students at the University of Kentucky administered the surveys. Surveys were administered at the time of the schools choosing (homeroom, English class, or after lunch). Each survey and consent form was coded, and consent forms were collected as the surveys were being administered to ensure that all participants' parent or legal guardian had provided consent. Surveys took approximately 30-40 minutes to complete. Students were mailed a check for \$25 following the completion of the survey. Responses to the survey were recorded using Research Electronic Data Capture (REDCap).

Independent Variable

Food Shopping Behaviors- Youth Impact Questionnaire

Survey questions from the Youth Impact Questionnaire were used to assess food-shopping behavior (Shin et al., 2015). The students were asked a variety of questions about beverages, fruit and vegetables, whole grains/grocery items, fast food, and snacks. These questions consisted of (1) how many times in the last seven days the food item was purchased, and (2) where the food item was purchased (supermarket, convenience store, corner store, fast food/carry-out, school/recreation center, or other). (See appendix for full survey)

NHANES 2009-2010 Dietary Screener Questionnaire

Dietary intake was measured using the NHANES 2009-2010 Dietary Screener Questionnaire (Thompson et al., 2009). The Dietary Screener Questionnaire is 26 questions about the frequency of selected foods over the past month. The questionnaire is

used to assess the intakes of fruits and vegetables, dairy/calcium, whole grains/fiber, added sugars, red meat, and processed meat.

BMI

BMI was derived using the answers to the weight (pounds) and height (feet and inches) questions.

Covariates

Participants were asked via free response question about their age. Gender was also asked, but options of female, male, transgender male to female, and transgender female to male were given. Race and ethnicity were separated into two different questions. For race, the participant was able to choose from: American Indian, Asian, Black, Native Hawaiian/Pacific Islander, White, Unknown, or other. For ethnicity, participants could choose from: Hispanic Cuban, Hispanic Mexican American, Hispanic Puerto Rican, Not Hispanic/Latino, unreported, or Hispanic Other.

Analysis

Demographic information, as well as dietary intake, BMI, and food shopping venues of the participants were collected in the study. Food shopping venue, demographic information, dietary intake, and BMI were all treated as categorical variables. Chi-Square was used to compare key dietary outcomes with food shopping venue and BMI with food shopping venue. STATA was used to analyze the data.

Food Shopping Patterns were created based on a cluster analysis with alpha set at .05. There were three cluster groups derived from the analysis: 1) healthy shopping pattern (infrequent shopping at gas stations; convenience stores; fast-food restaurants), 2) moderate healthy shopping patterns (sometimes shops at gas stations; convenience stores;

fast-food restaurants), and 3) unhealthy shopping patterns (three times or more per week shopping at gas stations; convenience stores; fast-food restaurants). Cluster groups were used to assess the association between these groups on key dietary outcomes and purchases.

Chapter Four: Results

Of the 14 and 15 year olds from each of the eight counties, 432 completed the survey. Table 4.1 represents the demographic data. The predominant race of the participants was white, with 62%, 26% of the participants were black, and 12% were another race. The average age of the participants was 15 years old. Of the participants, 41% were female and 59% were male. BMI was also measured. Fifty-five percent of the participants were normal weight (18.5-24.9), 24% were overweight (25-29.9) and 21% were obese (30+).

Table 4.1: Demographics

Demographics	Total
Race	
<i>White</i>	62%
<i>Black</i>	26%
<i>Other</i>	12%
Average Age in Years	15
Gender	
<i>Female</i>	41%
<i>Male</i>	59%
Body Mass Index	
<i>Normal</i>	55%
<i>Overweight</i>	24%
<i>Obese</i>	21%

Table 4.2 represents the locations of food purchases and the percentage of people who purchased specific food items from each store. The locations represented in Table 4.2 are: supermarket, convenience store, and fast food. The specific food items from each food venue include: fruits and vegetables, fast-food, snacks, healthy beverages, and unhealthy beverages. Snacks were broken down into different categories including chips or cheese curls, baked chips, dried fruit, nuts, or seeds, and baked goods (cookies, cakes, donuts, popartarts). Within healthy beverages, water, flavored water, diet soda, and skim

milk were represented in Table 4.2. For unhealthy beverages, subcategories for regular soda, whole milk, sports drink, sweet tea, and energy drink were included in Table 4.2.

Table 4.2 Locations of Food Purchases

Locations of Food Purchases	Total
Supermarket	
<i>Fruits and Vegetables</i>	85%
<i>Fast-Food</i>	58%
<i>Snacks</i>	76%
Chips or Cheese Curls	63%
Baked Chips	57%
Dried Fruit, Nuts or Seeds	68%
Baked Goods (Cookies, Cakes, Donuts, Poptarts)	67%
<i>Healthy Beverages</i>	72%
Water	65%
Flavored Water	62%
Diet Soda	54%
Skim Milk	77%
<i>Unhealthy Beverages</i>	59%
Regular Soda	53%
Whole Milk	78%
Sports Drink	57%
Sweet Tea	44%
Energy Drink	47%
Convenience Store	
<i>Fruits and Vegetables</i>	13%
<i>Fast-Food</i>	12%
<i>Snacks</i>	40%
Chips or Cheese Curls	21%
Baked Chips	21%
Dried Fruit, Nuts or Seeds	22%
Baked Goods (Cookies, Cakes, Donuts, Poptarts)	19%
<i>Healthy Beverages</i>	46%
Water	13%
Flavored Water	16%
Diet Soda	20%
Skim Milk	11%
<i>Unhealthy Beverages</i>	42%
Regular Soda	22%
Whole Milk	12%
Sports Drink	26%

Sweet Tea	14%
Energy Drink	31%
Fast-Food Restaurant	
<i>Fruits and Vegetables</i>	4%
<i>Fast-Food</i>	77%
<i>Snacks</i>	9%
Chips or Cheese Curls	1%
Baked Chips	4%
Dried Fruit, Nuts or Seeds	1%
Baked Goods (Cookies, Cakes, Donuts, Poptarts)	3%
<i>Healthy Beverages</i>	16%
Water	1%
Flavored Water	2%
Diet Soda	6%
Skim Milk	3%
<i>Unhealthy Beverages</i>	15%
Regular Soda	11%
Whole Milk	0%
Sports Drink	3%
Sweet Tea	30%
Energy Drink	N/A

As represented in Table 4.2, of those who shopped at supermarkets, 85% purchased fruits and vegetables, compared to 13% and 4% at convenience stores and fast-food respectively. 76% of the participants that shopped at supermarkets, 40% of the participants that shopped at convenience stores, and 9% of those that purchased food from fast-food restaurants purchased snacks. Healthy beverages were also more likely to be purchased at supermarkets with 77%, compared to 46% at convenience stores and 16% at fast-food restaurants. Water, an example of a healthy beverage, was purchased at a supermarket 65% of the time, purchased at a convenience store 13% of the time, and from a fast-food restaurant 1% of the time. On the other hand, 59% of supermarket shoppers purchased unhealthy beverages, as well as 42% of convenience store shoppers and 15% of fast-food shoppers.

Table 4.3 Food Shopping Patterns and Dietary Intake and BMI

Dietary Intake	Shopping Pattern Group**	
	Moderate Shopping	Unhealthy Shopping
Fruit and Vegetable (cup)	-0.01 (-0.11, 0.01)	0.06 (-0.08, 0.02)
Fruit (cup)	-0.01 (-0.06, 0.04)	0.02 (-0.05, 0.09)
Vegetable (cup)	0.04 (-0.03, 0.11)	0.09 (-0.001, 0.19)
Added Sugar (tsp)	0.41 (-0.64, 1.45)	2.41 (0.99, 3.82)*
Sugar Sweetened Beverages (tsp)	-0.01 (-0.05, 0.02)	0.01 (-0.03, 0.06)
BMI Group***		
Overweight	0.44 (-0.26, 1.13)	-0.1 (-1.08, 0.87)
Obese	0.26 (-0.47, 0.99)	0.11 (-0.84, 1.06)

*P-value <0.05

**Reference Group: Healthy Shopping

***Reference Group: Normal Weight

Table 4.3 was created using a cluster analysis of shopping pattern groups. Next, a linear regression was performed looking at the shopping pattern groups and dietary intake adjusted for age, race, and gender. BMI was also compared to the shopping pattern groups. The results show that those with moderate shopping patterns (sometimes shops at gas stations; convenience stores; fast-food restaurants) consumed 0.01 cups less than those with healthy shopping patterns (infrequent shopping at gas stations; convenience stores; fast-food restaurants), and those with unhealthy shopping patterns (3 times or more per week shopping at gas stations; convenience stores; fast-food restaurants) consumed 0.06 cups more than those with healthy shopping patterns. In addition, those with moderate shopping patterns consumed 0.41 teaspoons more added sugar and those with unhealthy shopping patterns consumed 2.41 teaspoons more added sugar than those with healthy shopping patterns, which was statistically significant with a p-value of less than 0.05. Sugar sweetened beverages had little variation with 0.01 teaspoons less for participants with moderate shopping patterns and 0.01 teaspoons more for those with unhealthy shopping patterns.

BMI was also a variable for shopping patterns. The results in Table 4.3 show that overweight participants are 0.44 times more likely to have moderate shopping patterns and -0.1 times more likely to have unhealthy shopping patterns than those of a normal weight. Obese participants are 0.26 times more likely to have moderate shopping patterns and 0.11 times more likely to have unhealthy shopping patterns compares to participants with a normal weight. Results from BMI and shopping patterns were not statistically significant.

Chapter Five: Discussion

The aims of this study were to first, determine the association between food shopping and dietary intake, and second, the association between food shopping and BMI. Overall, this sample has similar purchasing habits to the general population of adolescents (Poti & Popkin, 2011). In particular, two key findings are presented in such that there are more overall healthy purchases conducted in supermarkets and supercenters compared to gas stations, fast-food venues, and convenience stores. In addition, it is not surprising there were no direct effects between food shopping and BMI (Richardson et al., 2015).

Our results follow an interesting pattern of food shopping practices among rural adolescents. Specifically, food shopping in supermarkets found a balance between healthy and unhealthy food purchased. In the first aim, a key finding was more healthy food items (fruits, vegetables, and water) were purchased at supermarkets more than at convenience stores, gas stations, and fast-food venues. This finding is similar to previous studies indicating that shopping at supermarkets tends to predict purchasing healthier items (Larson et. al, 2009). However, others have found that supermarkets are the largest food venue for both healthy and unhealthy food items (Vaughan et al., 2014). This finding suggest that adolescents purchase healthy food at these types of venues, but based on the data presented, also purchase unhealthy items with relatively high frequency as well. Some of these unhealthy items include chips and cheese curls, baked goods including poptarts and donuts, and unhealthy beverages like whole milk and regular soda. In similar research, adolescent trends point to unhealthy foods purchased at supermarkets (Drewnowski & Rhem, 2014). These unhealthy foods are high in sugar. The majority of

these high sugar items are unhealthy beverages like regular soda and sports drinks (Drewnowski & Rhem, 2014). Although our sample reflected healthy purchases at supermarkets, there were also a high percentage of unhealthy purchases as well. Indicating that this type of food venue can allow an opportunity to encourage more healthy purchases among this population (Liese et. al, 2017).

In food shopping patterns within convenience stores, results showed that adolescents are three times more likely to purchase snacks than they are fruits and vegetables. Similarly, other studies have found that adolescents with greater access to convenience stores consume less fruits and vegetables (Larson et. al, 2009). Another study found that adolescents frequently purchase energy-dense snacks at convenience stores (Sanders-Jackson et al., 2015). However, other studies have found that there are healthy food options available in the majority of convenience stores; almost half even offer fresh fruits and vegetables (Gebauer & Laska, 2011). Although these healthy food options are available at convenience stores, a reason that adolescents typically choose more unhealthy and energy-dense snacks may be because advertisements showcase unhealthy snacks and healthy snacks are not as plentiful as unhealthy. Overall, adolescents are more likely to purchase unhealthy snacks than fruits and vegetables from convenience stores regardless of the availability of healthy options.

In food shopping patterns within fast-food, very few fruits and vegetables were purchased. More surprisingly, just as many healthy beverages were purchased as unhealthy beverages by adolescents. These findings are similar in other reports indicating that there has been an overall increase in low-calorie beverages being purchased throughout the US. (Piernas & Popkin, 2013). However, others found that sugar

sweetened beverage consumption, particularly soda, has increased 300% from 1988 to 2008 (Harrington, 2008). The results may have shown an equal amount of healthy and unhealthy beverages being purchased at fast food restaurants because trends have shifted towards low calorie beverage choices including diet soda and flavored water. Overall, even though fast-food venues offer many varieties of unhealthy beverages, adolescents purchase healthy beverages just as often as unhealthy beverages.

We then assessed direct association between shopping patterns (healthy, moderate, and unhealthy) and dietary intake. Added sugar was significant among the unhealthy shopping pattern group with more than five times more than the moderate shopping pattern group. This is in agreement with research done by Moreland et al. that those who shop more frequently at convenience stores consume more added sugar than those who shop predominately at supermarkets. Sugar sweetened beverages, on the other hand, did not vary among the different categories of shoppers. Previous research also found that people who live closer to convenience stores and fast food restaurant are also known to consume more added sugar than those who shop at supermarkets more frequently (Rose & Richards, 2004, Michimi & Wimberly, 2010, Jilcott et al., 2011).

The differences in fruit and vegetable intakes were not significant between the different types of shopping patterns. This is in contrast with previous research that found that those who live further from supermarkets consume fewer fruits and vegetables than those who live closer to supermarkets (Rose & Richards, 2004, Michimi & Wimberly, 2010, Jilcott et al., 2011). However, our study did not measure proximity to stores. Our methods documented the food stores where adolescents reported shopping and specifically asked where they buy certain food categories. By only asking proximity or

distance, this doesn't take into account food shopping patterns (Gustafson et. al, 2013). Fruit and vegetable intake were not significantly different among different shopping pattern groups because the whole sample did not consume enough fruits and vegetables. Therefore, across the board, there is no variance. This sample population does not consume enough fruits and vegetables because of rural disparities in the dietary intake of fruits and vegetables and the overall food environment.

The second aim was to determine the association between food shopping and BMI was then studied. Our results showed that food-shopping patterns had no significant relationship to BMI among rural adolescents. These results are similar to previous research that found that food stores do not have an association with BMI through diet (Richardson et al., 2015, Block et al., 2011). Alternatively, other research has found those who shop at supermarkets more frequently than convenience stores and fast food venues have a lower BMI (Jilcott et al., 2011, Rose & Richards, 2004). A possible explanation for the insignificance of BMI as a result of food shopping patterns is that BMI is very complex and difficult to change. With a cross-sectional study, there are so many variables that influence BMI and thus it's typically hard to find a direct association between more distal determinants such as food shopping patterns. Overall, there was no association between food shopping patterns and BMI.

Overall, this research emphasizes the importance of the food environment of rural adolescents. This can serve as a basis for developing health interventions and making changes in the food environment in rural areas. It is important to target rural adolescents because their overweight and obesity rates are 45%, making them a vulnerable population and at a higher risk of developing chronic disease in the future. While projects such as the

Healthy Corner Store Initiative are being implemented in urban areas, rural communities have a need for accessibility to healthy food options as well given that 23% of the U.S. population lives in rural areas (Befort et al., 2012).

Limitations

There were a few limitations with this study. First, the cross-sectional survey design does not allow causal inference with food store choice and dietary outcomes and BMI. The cross-sectional survey design also allowed self-reported response, which may have altered the results if social desirability was a factor. Also, there was a limitation of self-selection due to the nature of the survey and the required consent forms from a parent or guardian. Next, the study lacks generalizability because the sample population of rural adolescents in Kentucky and North Carolina may not be representative of all rural adolescents in the country. Last, from primary data collection done in the schools, the health literacy of the sample population may have had an impact on study results.

Implications

This research shows that there is a need for availability and accessibility to healthy foods in rural areas. Interventions focusing on making fruits and vegetables more available to rural adolescents would benefit the rural communities. Also, health education, specifically nutrition education, should be emphasized in all public schools in hopes of increasing fruit and vegetables consumption and decreasing BMI in adolescents.

Recommendations for Future Research

For future research, it would be beneficial to look at rural communities in other areas of the country to make the study more generalizable to all rural adolescents in the U.S. Although expensive, it would be beneficial to do a cohort study to determine causal

inference if food environment really does have an impact on the food purchased and consumed.

Appendix

DIETARY QUESTIONS

During the last month how often did you eat these types of food?	Ne ver	1-2 times/ month	1-2 times/ week	3-4 times/ week	5 or more times/ week
Hot or cold cereals type(s): _____ _____					
Fruit, including fresh, frozen or canned NOT juices					
Green leafy/lettuce salad, with or without other veggies					
Any type of fried potatoes, French fries, home fries, or hash browns					
Any other type of potatoes, like baked, boiled, mashed, sweet, or potato salad					
Refried beans, baked beans, beans in soup, pork and beans or any other type of cooked/dried/canned beans					
Brown rice or other cooked whole grains, such as bulgur, crack wheat or millet NOT white rice					
Other vegetables (not including green salads, potatoes, cooked/dried beans)					
Mexican-type salsa with tomato					
Pizza, including frozen, fast food, and homemade pizza					

Tomato sauces such as with spaghetti or lasagna Do NOT include tomato sauce on pizza					
Cheese, including cheese as a snack, cheese on burgers, sandwiches, cheese in food like quesadillas or casseroles, Do NOT include cheese on pizza					
Red meat, such as beef, pork, ham, sausage, veal, or lamb Do NOT include chicken, turkey or seafood Include red meat you had in sandwiches, lasagna, stew and other mixtures					

During the last month how often did you eat these types of food?	Never	1-2 times/month	1-2 times/week	3-4 times/week	5 or more times/week
Whole grain bread, including whole wheat, rye, oatmeal and pumpernickel, including toast rolls and in sandwiches NOT white bread					
Chocolate or any other types of candy Do not include					

sugar-free candy					
Doughnuts, sweet rolls, Danish, muffins, pan dulce or Pop-Tarts Do not include sugar-free items					
Cookies, cake, pie or brownies Do not include sugar-free kinds					
Ice cream or other frozen desserts Do not include sugar-free kinds					
Popcorn					

SHOPPING BEHAVIOR

Please indicate if you purchase food at any of the following locations:	Never	1-2 times/month	1-2 times/week	3-4 times/week	5 or more times/week
School cafeteria					
Receives school lunch					

Purchasing a la carte items					
School vending					
School fundraiser					
Gas station or Convenience Store					
Fast-food restaurant (like McDonald's)					
Sit-down restaurant (like Applebee's)					
Dollar Store					
Farmers' market					
Super market (like Kroger or Save-A-Lot)					
Super center (like Walmart)					

Food Item	# times purchased in the last 7 days	Where did you usually buy this food?					
		Super market	Convenience Store	Corner Store	Fast Food/ Carry-Out	School/ Rec Center	Other (write place)
Beverage							
Regular Soda (Brand(s): _____)							

Diet Soda (Brand(s): _____ _____)							
Fruit punch or Hugs fruit drink							
100% Fruit Juice (Brand: _____ _____)							
Plain Water							
Fruit flavored water (Brand: _____ _____)							
Sugar free drink mixes							
Whole milk							
2% Milk							
1% or skim milk							
Sports drinks							
Sweetened iced/Half and half							
Unsweetened tea/diet half and half							
Energy drinks							
Any other drinks (Type: _____ _____)							
Food Item	Where did you usually buy this food?						

	# times purch ased in the last 7 days	Super market	Conve nience Store	Co rne r Sto re	Fas t Fo od/ Ca rry - Ou t	Sch ool/ Rec Ce nte r	Ot he r (w rit e pl ac e)
Fruits and Vegetables							
Apples							
Applesauce							
Bananas							
Oranges							
Other fresh fruit (Type: _____ _____)							
Frozen fruit (Type: _____ _____)							
Canned fruit/Fruit cups							
Dried fruit							
Baby carrots							
Celery							
Cucumber							
Other fresh/frozen vegetables (Type: _____ _____)							
Canned vegetables							
Any other fruit or vegetables							

(Type: _____ _____)							
Whole Grains/Grocery Items							
White bread							
100% Whole wheat bread							
Sugary Cereal (like Froot Loops, Brand(s): _____)							
Low sugar cereal (like cheerios, rice krispies, Brand(s): _____)							
High fiber cereal (like bran flakes, Brand(s): _____)							
Hot cereal (oatmeal, grits)							
Tuna (canned)							
Cooking spray							
Any other groceries (Type: _____)							
Food Item	Where did you usually buy this food?						

	# times purch ased in the last 7 days	Super market	Conve nience Store	Co rne r Sto re	Fas t Fo od/ Ca rry - Ou t	Sch ool/ Rec Ce nte r	Ot he r (w rit e pl ac e)
Fast Food							
Hamburger or Cheeseburger							
Pizza							
Fried chicken							
Fried seafood							
Grilled seafood							
French fries or tater tots							
Fruit side dish (Type: _____ _)							
Vegetable side dish (include green salad) (Type: _____ _____)							
Subs/sandwiches/ wraps (like cheesesteaks, fried chicken or fish) (Type: _____ _____)							
Subs/sandwiches/ wraps (sliced deli meat)							

(Type: _____ _____)							
Chinese Food							
Tacos/ burritos/ nachos/quesadilla							
Any other carry- out food (Type: _____ _____)							
Any other carry- out food (Type: _____ _____)							
Snacks							
Pretzels							
Chips or cheese curls (Type(s): _____ _____)							
Baked chips (Type(s): _____ _____)							
Reduced-fat chips (Brand: _____ _____)							
Dried fruit, nuts or seeds							
Food Item	# times purch ased in the last 7 days	Where did you usually buy this food?					
		Super market	Conve nience Store	Cor ner Sto re	Fas t Fo od/ Ca rry -	Sch ool/ Rec Ce nte r	Ot he r (w rit e pl

					Out		ac e)
Baked goods (cookies, cakes, donuts, poptarts)							
Yogurt							
Granola bars							
Chocolate candy							
Other candy (like skittles, gummy bears, life savers)							
Ice cream							
Juice popsicles							
Snow cones or snow balls							
Any other snacks (Type: _____ _____)							

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